CONDUCTING POLLUTION PREVENTION AUDITS

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INTRODUCTION

Pollution prevention (P2) or waste reduction saves companies money. After all it is only process improvement by another name. Therefore, P2 also often improves product quality, motivates employees, and provides environmental benefits.

The most common mistake made during waste reduction (WR) audits is in not asking WHY often enough. A WR audit follows the same principles as any other audit. You are basically determining and documenting what's going on, i.e. the process in place. There is a wealth of information on both conducting P2 audits and technical issues and options. However, too often people accept the first answer given about why a particular waste is generated and so do not identify the real root cause.

True Cost of Waste - One reason relatively few companies or facilities pursue P2 aggressively is they don't know the true total costs of their wastes. Orr & Boss, industrial consultants, reported in 1994 that for many manufacturing operations the total cost of wastes exceeds the cost of labor. Sometimes the total costs of waste is 2-5 times the cost of labor. Most of this cost is overlooked and undocumented by most companies. The primary cost tracked by most companies is waste disposal cost. Yet according to Orr & Boss this normally represents only 5-10 percent of the true total costs for waste materials.

The major cost which is undefined is the value of the raw materials, labor and other process costs which are contained in every waste material. For example, a company making pressed plastic parts found that its true total cost of waste was $4.30 million per year while labor was only $2.75 million per year. Of this total disposal costs only accounted for 3.5 percent. Lost raw materials was over 93 percent. Another company assisted by Orr & Boss had waste cost over three times their labor cost. Over 96 percent was lost raw materials while only 2.2 percent was disposal cost.

The primary cost of waste is wasted process input materials. This can be found or concealed in: loss allowances, production variances, scrap and obsolescence, and

inventory shrinkage. Another cost which may be overlooked is the cost of cleanup of spills. This should include: cleanup materials, labor, and cost of disposal. The fees for disposal of waste are usually tracked, however, the personnel time to comply with regulations and complete all necessary reports usually disappears into plant or corporate overhead.

According to Green Ledgers: Case Studies in Corporate Environmental Accounting , edited by Ditz, Ranganathan, and Banks, and published by the World Resources Institute in 1995; traditional cost accounting often "hides" environmental costs in two ways: by burying them in nonenvironmental accounts and by failing to link costs to the activities which create them.

A classic example would be a company which was a large quantity generator because of paint waste generated once per year during the cleaning out of a large dip tank. Because this occured during their annual maintenance outage, the disposal of this waste was charged to maintenance not to the production process utilizing the paint tank. Another example are companies which charge all disposal fees and other environmental costs to plant overhead and thus mask the fact that one product line is responsible for 70 percent of the facilities waste costs.

For similar reasons many facilities often pride themselves on the extent of their recycling program, because they do not realize that they are at best recovering pennies out of the dollars spent for the same materials. For example a steel company prided itself on keeping all metal scrap segregated so it could command top prices for its recycled metal. It averaged $200 per ton for its recycled steel. It was paying $500 per ton for the input steel, and the steel was worth $700 per ton if it was in finished product. The company also had an aggressive program to ensure that employees used any scrap internally if possible. However, most of the scrap was rod steel approximately six inches long from cutting long lengths to the proper size for their product. A P2 audit which focused on the root cause, suggested asking the supplier to provide the rods cut the the proper length and the company saved almost $400,000 per year with a phone call.

P2 AUDITS

A P2 audit is NOT nuclear physics. It is basically consists of getting accurate answers to the following questions:

- Where are the wastes generated (process, machine, department)?
- Why are the wastes generated (spills or leaks, by-products, inefficiencies)?
- What wastes are being generated (type and amount)?
- Where does the waste go (treatment, recycling, or disposal)?
- What does it cost (treatment, handling, labor, chemicals, disposal)?

Every P2 audit requires team work. The presentation after the break will talk about setting up an in-house team, both to conduct audits and to ensure implementation and continuing improvement. Teams are essential because P2 can be impacted not only by

production, but also by purchasing, maintenance, inventory management, and other activities or processes.

Preparation - The team should prepare by considering management's concerns about costs and environmental issues. The team should coordinate with facility personnel which may be involved in the audit to ensure that the proper people are present to answer questions during the audit. Organize a facility audit into process groups and processes into unit operations to assist in understanding the total operation. Keep the audit in perspective. Do not institute a $100,000 process to solve a $10,000 problem. Use common sense and available data or assumptions to scope out the process.

An audit is like a mass balance. What goes in goes out somewhere! If process flow diagrams linking unit operations do not exist, then construct them based on readily available information. These will help quickly identify discrepancies between the input and output balance and help prioritize the audit. Sources of existing information may include, but are not limited to the following:

- permit applications (air, NPDES, etc.),
- permit compliance reports,
- Toxics Release Inventory (TRI) reports,
- utility bills (water, sewer, electricity, gas, etc.),
- landfill tickets,
- hazardous wastes shipping manifests,
- purchasing records, and
- material safety data sheets (MSDS).

After the process flow sheets are developed, refine them to the degree possible. Make sure that all process inputs are included, raw materials and energy. Add all process outputs, including: products, by-products, wastewaters, gaseous emissions, solid and hazardous wastes, and waste heat or energy. Document current levels of waste reuse or recycling. Then quantify each unit operation input and output with volume or mass, characteristics, and especially costs. Note any gaps in the information so the in-plant audit can try to provide the missing data.

As you prepare the process flow sheets consider the potential impact on waste generation from the following factors: process design; equipment (pipes, vessels, boilers, etc.); operator skills and/or training (start-up, shut-down, emergencies); preventative maintenance; instrumentation & controls; and energy conservation (waste heat and power). Remember the need to determine the root cause of each waste stream. The preceding factors may hold the answer to WHY a waste is being generated.

In-plant Facility Audit or Walk-down - As the team goes through the facility remember to use all your senses (sight, hearing, and smell) to detect wastes. The checklists in P2 manuals or guidelines are a good beginning point for auditing a particular process or facility. However, they can be dangerous in that they may limit your teams observations and ideas. A descriptive approach where you attempt to describe the process as

completely as practicable helps prevent overlooking a waste simply because it was not on the checklist.

Keep the following factors in mind: material handling & flow; housekeeping; air discharges, fumes or odors; poor segregation of wastes; running hoses; steam, pump or air leaks; storage methods; and maintenance procedures. Segregation is very important for P2. Mixing wastes often makes it more difficult to determine the root cause of each waste. Also small concentrated streams are easier to reuse, recycle or treat than large, dilute streams. Streams with few contaminants are easier to reuse, recycle, or treat than complex mixtures.

Raw material losses such as remnants from batch processes, overfilling of tanks, or leaking seals or pumps even small ones usually have major impacts because these losses are typically of pure (concentrated) materials.

Common wastes present in most facilities include: solvents, paints, plastics (shrink wrap or polystyrene), cardboard, pallets, equipment cleaning, office wastes and hydraulic fluids. Even during a waste reduction assessment some waste types are often overlooked. These include: damaged raw materials; underdelivery; unused raw materials; low power factor; inefficient lighting; wasted labor; spills & leaks; scrap, obsolesence, and rework; equipment cleaning wastes; overfilling orders or overspecifying products; and excess heat.

Audit Results - The audit should enable the team to complete the process flow diagrams and quantify what wastes are being generated, where, and why. Immediate benefits include an increased knowledge of processes, process inefficiencies, and costs. Information generated by the P2 audit should include:

- quantity of waste(s) generated per production unit or activity
- material toxicity, both in raw material components and in waste(s)
- raw material consumption or use per production unit
- costs

Data must be normalized to avoid being skewed by production levels or other factors. Some possibile factors include: units produced; area, weight or volume of product; hours of labor; or hours of production.

The team should prioritize the results based on the existing costs of each waste, the potential benefits (especially cost savings) of reducing or eliminating each waste, potential production impacts, the costs and resources required for each waste reduction option, existing and potential liabilities (usually reduced) and resources available.

The team should brainstorm to identify waste reduction or P2 opportunities. They should target problem areas based on: costs, operating problems, liability, or disposal difficulties. They should evaluate the feasibility of each option, including waste segregation. Many P2 options can be implemented at low cost. These are often referred to as “low hanging fruit” and may include:

- preventative maintenance (don't let process materials escape)
- good housekeeping (don't let materials get dirty or damaged)
- substitute non-hazardous materials for hazardous or toxic materials
- inventory control (don't buy more than is needed and don't let it spoil in the warehouse)
- segregate waste materials and reused in the same process
- charge waste costs to unit producing them

Cleaning Process Example - Cleaning is a process common to many facilities and operations. One way to get to the root causes of cleaning wastes is to ask if the cleaning process is necessary. One company which was evaluating changing from solvent to aqueous parts cleaning decided to first determine how clean the parts had to be. They found that the cleaning step was unnecessary and eliminated the whole process. Ways to avoid the need for cleaning include: storing parts or materials indoors or in cleaner areas, just-in-time delivery, covering materials with shrink wrap instead of greasy coatings, and improving coating processes to reduce rejects and the need to strip and clean parts.

Other source reduction options for cleaning include:
- changing to non-detergent cleaning using hot water and/or high pressure
- extend solution life (continuous filters, oil skimmers, etc.)
- minimize losses through drag-out reduction and pre-cleaning inspections
- ensuring proper makeup and mixing of cleaning solutions
- monitoring and maintaining cleaning solutions at proper concentrations

REPORTING

A written audit report should be done. Written reports aid consistent implementation of P2 concepts and processes. It should include the waste reduction options considered and the mass balances and flow diagrams to support the recommendations of the team. The report may also help sell ideas to management. Costs are especially important because that is usually the critical hurdle that must be overcome to get projects implemented.

IMPLEMENTATION

Audits only identify P2 options. Each facility must decide what and how to implement based on its priorities. It is often best to implement the low cost "low hanging fruit" first to build confidence in the P2 process. The P2 team or upper management should set waste reduction goals for each high priority waste stream, assign responsibilities, set schedules, and just do it.

Unfortunately at many facilities a P2 audit is a separate task apart from routine activities. To ensure continuous improvement routine measurements are required. After all costs and technology are continually changing. P2 measurements should become a routine way of doing business. To make meaningful measurements you should: establish a baseline, track progress of indicators, and quantify each process and its wastes.

One benefit of the geometric increase in the power of microchips is that we can measure, cost-effectively, processes that we could not a decade past. There are instruments, bar codes, and computer tracking systems that enable us to measure and analyze data that was simply unobtainable. However, measurements alone are worthless. Data must be analyzed or evaluated to serve any useful purpose. Just as we must continually ask why each waste is being generated, we must continually ask why measurements are being taken.

SUMMARY

Waste reduction or pollution prevention are only other words for process efficiency improvement. P2 saves money. It is not usually high-tech or very complicated. P2 requires measuring current processes and wastes, setting goals, and moving ahead to a more efficient future.